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E L E M E N T S

O F

A G R I C U L T U R E

A N D

V E G E T A T I O N .

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L O N D O N ,

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MDCCLXXI.

ELIENIT

RIGHT HONORABLE

JAMES STUART MCKINNEY

AGRICULTURE

THE

FOR THE

ALCOHOL

WITH THE

BY GEORGE

OF THE

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THE

TO THE
RIGHT HONORABLE
JAMES STEWART MACKENZIE,
LORD PRIVY SEAL FOR SCOTLAND,

THE FOLLOWING ATTEMPT IN A SCIENCE,
NOT LESS HONORED BY HIS ENCOURAGEMENT
THAN USEFUL IN ITSELF,

IS,

WITH DUE RESPECT AND GRATITUDE,

INSCRIBED

BY

HIS MOST OBLIGED

AND MOST HUMBLE SERVANT,

GEORGE FORDYCE.

TO THE

RIGHT HONORABLE

JAMES STEWART MACKENZIE

LORD PRIVY SEAL FOR SCOTLAND

THE FOLLOWING ATTEST IN A CORNER

NOT RECORDED BY HIS EXCELLENCY

THAN BEFORE IN 1788

18

WITH THE RESPECT AND GRATITUDE

RESPECTED

BY

HIS MOST OBLIGED

AND MOST HUMBLE SERVANT

GEORGE FORDYCE

ELEMENTS

OF

AGRICULTURE, &c.

PART I.

ELEMENTS OF CHEMISTRY,

Necessary to be understood for the Explanation
of the Principles of AGRICULTURE.

MECHANICS, treat of the Properties
belonging indifferently to all kinds of
Matter.

CHEMISTRY, treats of those Properties
which belong to particular Bodies only, and do
not arise from their Organization.

B

PHYSIOLOGY;

PHYSIOLOGY, is the Doctrine of animated Matter.

SUBSTANCES combine together ;

First, **MECHANICALLY** ; by being divided into small Particles, and mixed by *External Force*.

Secondly, **CHEMICALLY** ; by an Attraction of the Particles of one Body to those of another.

The Particles of Bodies do not touch, but adhere by Attraction. Vid. Fig. 1.

MECHANICAL COMBINATION is of two kinds.

First, **MIXTURE** ; when the Particles of one of the Bodies attract one another stronger, than they do those of the other ; in this Case if they be both Fluid, the one which is least in Quantity, is broke down into Spheres : *Example*, As Oil is when mixed with Water. Vid. Fig. 2.

Secondly, **DIFFUSION** ; when the Particles of the one Body, attract those of the other, as strongly, as they do one another, in this Case they intermix together equally : *Example*, As Solution of blue Vitriol mixes uniformly with Water ; or in the same Manner as Serum and Water. Vid. Fig. 3.

In Mechanical Combination, the Properties of the Elements remain exactly the same as before the

the Mixture, and the Properties of the Compound depend on them.

When of different specific Gravity, they remain mixed from Friction, and the Attraction of the Particles of the one, in the largest Quantity to one another. Vid. Fig. 4.

In CHEMICAL COMBINATION the Substances unite by an Attraction, which takes Place between themselves, without any external Power.

A Particle of each Element unite together, so as to form but one Particle considered Mechanically. Vid. Fig. 5. *Example,*

Nitrous Acid,	}	Form NITRE, which is to be considered Mechanically, as one simple Substance.
and		
Fixt Vegetable Alkali.		

The Properties of the Compound do not depend on the Properties of the Elements.

No Mechanical Power can separate the Substances so combined.

A Compound may become an Element. Vid. Fig. 7.

When two Substances are to be combined Chemically, we call one of them the *Menstruum*, the other the *Solvend*.

A Menstruum, or Dissolvent, will only combine with a certain Proportion of a Solvend:

B 2

Example

Example, Water will only dissolve a certain Quantity of Salt, and no more.

During the Combination, Heat or Cold are often produced: *Examples*, Vitriolic Acid in uniting with Water, and quick Lime in uniting with Water, generate Heat. Sal Ammoniac and Water, Air and Water, generate Cold,

A Menstruum will sometimes dissolve several Solvends at a Time, sometimes only one, as Water will dissolve several neutral Salts at once, but an Acid will only dissolve one Metal at a Time.

The Elements remain combined from the Attraction which takes Place between them.

TWO SOLIDS mechanically mixed may be separated;

First, By ELUTRIATION; that is separating two Bodies in Powder by means of Water. If one of the two is of greater Specific Gravity, or if the Particles of the one, are finer than those of the other, and both insoluble in Water; if they be mixed with Water, the heaviest, or that whose Particles are largest, will subside first, and the Water may be poured off while the other is still swimming in it. *Example*, Clay and Sand may be separated in this Way; the Clay being finer than the Sand, will remain longer suspended, and therefore may be poured off with the Water.

Secondly,

Secondly, By DISSOLVING one of them in a Menstruum, in which the other is insoluble:

Example, An Acid dissolves calcareous Earth, but not Sand; therefore these two Substances may be separated by pouring upon them an Acid, which dissolving the calcareous Earth, will leave the Sand.

Thirdly, By FILTRATION; if the Particles of the one, are finer than those of the other, by putting them with Water into a Filter, whose Pores will let the Particles of the one pass through along with the Water, the other remaining behind. *Example,* If Sand and Clay be mixed with Water, and poured into a proper Filter, the Clay will pass through the Water and leave the Sand

Fourthly, By EVAPORATION, which is the converting a Body into Vapour and dissipating it. If therefore a fixt and volatile Substance be mixed, we may separate them by evaporating the volatile one.

SOLIDS are Substances whose Particles have their Attraction of Cohesion, stronger, than the Attraction of Gravitation.

FLUIDS have their Attraction of Gravitation stronger, than their Attraction of Cohesion.

VAPOURS

VAPOURS have their Particles repelled to a considerable Distance, by a power, easily overcome by an external Pressure.

HEAT converts Solids into Fluids, and Fluids into Vapour.

Both these Changes generate Cold.

Evaporation is in Proportion to the Surface; for external Pressure prevents it from taking Place so readily, and there is the least Pressure on the Surface. Vid. Fig. 8.

A FLUID Mechanically mixed with a Solid may be separated;

First, By **FILTRATION**; (i. e.) making the Fluid pass through a Filter, whose Pores will not let the Solid pass through.

Secondly, By **SUBSIDING**; (i. e.) If they are of different specific Gravity, letting them stand together till the Solid has fallen to the Bottom, or risen to the Top.

This Separation takes Place more or less readily, according to the Difference of specific Gravity, the Size or Number of the Particles of the Solid.

Thirdly, By **EVAPORATION**; which may be performed when one is more Volatile than the other.

TWO

TWO FLUIDS may be separated from one another in the same Manner, *viz.*

First, By **FILTRATION**; when one is more viscid than the other.

Secondly, By **SUBSIDING**; when one is of greater specific Gravity than the other.

Thirdly, By **EVAPORATION**; when they are volatile at different Degrees of Heat.

TWO SUBSTANCES chemically combined, may be separated:

First, By **ELECTIVE ATTRACTION**; (i. e.) the Application of a third Substance, which will unite with one, and separate the other from it.

If calcareous Earth as Limestone be united with an Acid, and fixt Alkali as Pearl Ash be applied, the Alkali will unite with the Acid, and separate the Earth.

This can only happen when a Menstruum dissolves only one of two Solvents at a Time, the one uniting with it, repels the other, and is said to attract the Menstruum stronger.

Two Solvents may attract a Menstruum equally strongly.

In the following Tables of **ELECTIVE ATTRACTIONS**, the Menstruum is placed at the Top of the

the Column, and the Substances it will combine with, are placed under, in such Order, that if any one of them be combined with the Menstruum, any other that stands above it, will separate it; as for *Example*, If Silver be combined with an Acid, Mercury, Copper, an Alkali, or any other Substance standing above it, will separate it.

TABLE

Table of ELECTIVE Attractions.

A C I D S.

Phlogiston,

Fixt Alkali's,

Caustic Calcareous Earth,

Caustic Volatile Alkali,

Magnesia,

Zinc,

Iron, Lead, Tin,

Bismuth, Antimony,

Copper,

Regulus of Arsenic, Earth of Alum,

Mercury,

Silver,

Gold.

C

Table

Table of ELECTIVE Attractions.

ALKALI'S, and ABSORBENT EARTHS.

Vitriolic Acid,

Nitrous Acid,

Acid of Amber,

Muriatic Acid,

Acetous Acid,

Volatile Vitriolic Acid, Tartar, Acid of Borax,

Air,

Oils,

Table

Table of ELECTIVE Attractions.

M E T A L S.

Muriatic Acid,

Vitriolic Acid,

Nitrous Acid,

Acetous Acid,

Air.

Table of ELECTIVE Attractions.

A I R.

Calcareous Earth,

Alkali's.

Secondly, By

Secondly, By HEAT. If two Substances are combined, one of which is fixed, the other Volatile, by Heat we may often destroy the Attraction between them, and separate the Volatile one, by converting it into Vapour. If the Acid of Vinegar and Copper be combined so as to form Verdigrease, if that Verdigrease be exposed to a sufficient Heat, the Attraction will be destroyed, the Acid driven off, and the Copper left.

The Volatile Element cannot be converted into Vapour, until we have applied a sufficient Degree of Heat to destroy the Attraction, although it be Volatile *when separate*, in a much smaller Degree.

If a Compound consists of Elements, which are also compounded, these Elements may be decomposed by the Heat, and their Elements may also unite together, so as to form a Substance, which was not originally in the Compound exposed to the Action of the Fire; as for *Example*, If we distil Gum Arabic with a considerable Heat, there will come over an Oil, which did not exist in the Gum.

Thirdly, By COLD; for Menstruums often dissolve a larger Proportion of Solvends in Heat than in Cold; if therefore a Menstruum is saturated with a Solvend in Heat, upon cooling, part of the

the Solvend will be separated; as if boiling Water be saturated with Nitre, upon cooling, part of the Nitre will separate.

SUBSTANCES may act upon one another Chemically.

First, By **SOLUTION**; when two Substances combine together.

Secondly, By **PRECIPITATION**; when a Solvend unites with a Menstruum, and separates another from it; or when upon applying two or more Compounds, the Solvents of the one, unite with the Menstruums of the other.

By Precipitation we do not mean the subsiding, but the Chemical Separation.

Substances separated Chemically, require afterwards to be separated Mechanically, by the Means already shewn.

Thirdly, By **FERMENTATION**; i.e. a Change of the Properties of a Compound, without any Addition to, or Separation from, the whole Mass, but by a new Arrangement of the Elements. Or when a Compound consists of Elements which are also compounded; these Elements decompose one another, and form new ones, which reunite, and produce a Compound, having different Properties from the one, subjected to the Operation.

SUBSTANCES

SUBSTANCES in order to act Chemically upon one another, must almost always be Fluid, or in the State of Vapour.

CRYSTALLIZATION, is a Disposition in Bodies when they become solid, to form themselves into particular Shapes, and to run in certain Directions.

This Power is capable of overcoming very great Resistances. Hence Water in freezing often breaks the Vessel in which it is contained.

Salts in Crystallizing often take up Water in their Crystals.

All Substances are capable of Crystallization, excepting Animal and Vegetable Mucilages.

PART II.

The PROPERTIES of BODIES necessary to
be known in AGRICULTURE.

I. Of SALT S.

SALTS are Substances which will dissolve in Water, and will not burn; Tartar and its Compounds are Exceptions, as they will burn although they be Salts.

Volatile Alkali and its Compounds are Exceptions, in as far as they deflagrate with Nitre.

Quick Lime is an Exception, which although soluble in Water is not called a Salt but an Earth.

SALTS are,

First, SIMPLE or ELEMENTARY, such as cannot be divided into more simple Substances.

Secondly, COMPOUND, such as consist of other Substances more simple.

ELEMENTARY

ELEMENTARY SALTS are,

First, **ACIDS**; such Elementary Salts as unite with **Alkalis** into neutral Salts.

Secondly, **ALKALIS**; such Elementary Salts as are united with **Acids** form neutral Salts.

COMPOUND SALTS are,

First, **Neutral**, Compounds of **Acids** and **Alkalis**. *Example,*

Sea Salts consists of { **Muriatic Acid,**
Fixt Fossile Alkali.

Secondly, **Metallic**, Compounds of **Acids** and **Metals**. *Example,*

Green Vitriol consists of { **Vitriolic Acid,**
Iron.

Thirdly, **Earthy** Compounds of **Acids** and **Earths**. *Example,*

Selenites consist of { **Vitriolic Acid.**
Calcareous Earth.

D

SALTS

S A L T S

NAMES.

The Manner in which they
are found or produced.

VITRIOLIC ACID,

It is found in the Earth
in Sulphur.

Synonima,

Oil of Vitriol,

Spirit of Vitriol,

Oil of Sulphur,

Spirit of Sulphur,

Universal Acid,

Fossile Acid,

Sulphur consisting of Vi-
triolic Acid, and inflam-
mable Matter; exposed to
the Air, is decomposed the
inflammable Matter flying
off, leaves the Acid behind;
if therefore there be Sul-
phur, or any of its Com-
pounds in the Soil, Vitrio-
lic Acid, or some of its Com-
pounds may be produced.

It is produced in the
burning of all inflammable
Substances, when reduced
to a Charcoal.

It is the only Acid found
in the Air, excepting near
the Sea, and where there
are large Masses of putri-
fying Substances, and it
may be attracted from the
Air by Alkali's or Earths.

found in SOILS are,

Their PROPERTIES.

It unites with

First, Fixt vegetable Alkali, forming vitriolated Tartar.

Secondly, Fixt Fossile Alkali, forming true *Glauber's* Salts.

Thirdly, Iron, forming green Vitriol.

Fourthly, Copper, forming blue Vitriol.

Fifthly, Zinc, forming white Vitriol.

Sixthly, Calcareous Earth, forming Selenites.

Seventhly, Magnesia, forming *Magnesia Glauber's* Salts.

Eighthly, Clay, or Earth of Alum, forming Alum.

It attracts Alkalis and Earths, stronger than any other Acid.

S A L T S

NAMES.

The Manner in which they
are found or produced.

NITROUS ACID,

It is always produced by

Synonima,

the last Stage of Putrefac-

Spirit of Nitre,

tion, and is found either
in the putrid Mass, com-

Glauber's Spirit of

bined with Calcareous
Earth, or Volatile Alkali,
or in the Air near it.

Nitre,

Aqua Fortis.

found, in Soils are,

Their PROPERTIES.

It unites with

First, Fixt Vegetable Alkali, forming Nitre.

Secondly, Volatile Alkali, forming Nitrous Ammoniac.

Thirdly, Calcareous Earth.

Fourthly, Magnesia.

Its Compounds deflagrate with any inflammable Substance, i. e. the inflammable Matter unites with the Acid, and precipitates the Alkali; at the same Time there is a great Separation of Air, and a considerable Degree of Heat produced.

SALTS

S A L T S

NAMES.

The Manner in which they
are produced.

MURIATIC ACID,

Synonima.

Spirit of Salt,

Glauber's Spirit of

Salt,

Marine Acid.

It is found in the Earth,
in Mineral Waters, and in
the Sea, combined with the
fixt Fossile Alkali, Calca-
reous Earth, Magnesia, or
Earth of Alum.

It is formed by the Pu-
trefaction of Animal, or
Vegetable Substances, and
is found in the putrid Mass,
combined with Calcareous
Earth and volatile Alkali.

It is found in Soot, com-
bined with Volatile Alkali.

It is found in the Air near
the Sea.

found in **Sp I E S** are,

Their PROPERTIES.

It unites with

- First, **Fixt Fossile Alkali**, forming **Sea Salt**.
- Secondly, **Volatile Alkali**, forming **common Sal. Ammoniac**.
- Thirdly, **Iron**.
- Fourthly, **Copper**.
- Fifthly, **Zinc**.
- Sixthly, **Calcareous Earth**, forming **fixt Ammoniac**.
- Seventhly, **Magnesia**.
- Eighthly, **Earth of Alum**.

It attracts **Métals** stronger than any other **Acid**.

S A L T S

S A L T S

NAMES.

The Manner in which they
are produced.

Fixt Vegetable It is formed in the Burn-
Alkali ing of Vegetable Substances,
and is found in their Ashes.

Synonima, It is not an Element of
the Vegetable, but is pro-
duced from its Elements
Combined with Air by the Operation.

Salt of Tartar, It is not found in the
Salt of Wormwood, Ashes of Sugar, or in those
of any putrid Vegetable.

Pot-ash,

Pearl-ash,

Fixt Nitre,

When free from Air

Caustic fixt Veg. Alkali,

Common Caustic,

Soap Leys,

2 T I A 2

found in Soils are,

Their PROPERTIES.

It is either free from Air, when it is called **Caustic**; or Combined with Air, when it is called **Mild**.

In both Cases it unites with

First, **Vitriolic Acid**, forming **Vitriolated Tar-tar**.

Secondly, **Nitrous Acid**, forming **Common Nitre**.

Thirdly, **Muriatic Acid**, forming **Digestive Salt of Sylvius**.

It attracts Water from the Air.

When **Caustic**, it dissolves

First, **Oil**, forming **Soap**.

Secondly, **Animal and Vegetable Substances**, forming a **Soap**.

Both **Mild and Caustic**, it attracts **Acids stronger than Volatile Alkali, Metals, or Earths**.

E

SALTS

S A L T S

N A M E S.

The Manner in which they
are found or produced.

FIXT FOSSILE ALKALI

It is found in the Earth
and Mineral Waters, some-
times pure, sometimes com-
bined with Vitriolic, Nutri-
atic, or Boracic Acids, or
with Sulphur.

Synonyma,

Combined with Air

Natron, seu Nitrum

Plinii

Soda,

Sal Sodæ,

Barilla,

Kelp.

Upon burning any Ve-
getable containing Sea Salt,
it is found in the Ashes.

When free from Air

Soap Leys,

Caustic Fixt Fossile

Alkali.

found in SOILS are,

Their PROPERTIES.

It is either free from Air when it is called Caustic, or combined with Air when it is said to be mild.

In both Cases it unites with

First, Vitriolic Acid, forming *Glauber's Salts*.

Secondly, Muriatic Acid, forming Common or Sea Salt.

It dries in the Air.

It separates Volatile Alkali, Earths and Metals from Acids.

When Caustic it dissolves

First, Oils, forming Castile Soap.

Secondly, Animal and Vegetable Substances, forming a Soap.

S A L T S

N A M E S.

The Manner in which they
are found or produced.

VOLATILE ALKALI.

It is found in the Juices
of Animals, combined with

Synonima,

When dry and mild

Muriatic, and Phosphoric
Acids.

Volatile Salt of Sal

Ammoniac,

It is found in *Soot*,
combined with *Muriatic*
Acid.

Salt of Hartshorn,

Bones, Blood, or

any other animal

Substance,

When dissolved in

It is formed in the last
Stage of Putrefaction, and
is found in the putrid Mass,
combined with Nitrous, or
Muriatic Acids.

Water and mild

Spt. of Sal Ammoniac,

Spirit of Hartshorn,

&c.

It is never found in Soils
uncombined, on Account
of its Volatility.

When dissolved in

Water and Caustic

Spirit of Sal Am-

moniac with

Quick Lime.

found in Soils are,

Their PROPERTIES.

It is either free from Air, when it is called Caustic; or combined with Air, when it is said to be Mild.

In both Cases it unites with

First, Nitrous Acid, forming Nitrous Ammoniac.

Secondly, Muriatic Acid, forming common Sal Ammoniac.

Thirdly, Phosphoric Acid.

When Caustic it precipitates Magnesia, Earth of Allum, and all the Metals from any Acid, but not Calcareous Earth.

When Mild it also precipitates Calcareous Earth.

SALTS

S A L T S

COMPOUND SALTS are Combinations
Body, when that Compound has the Pro-

NEUTRAL SALTS; or Compounds of Acids

N A M E S.

The Manner in which they
are found or produced.

VITRIOLATED It is contained in the

TARTAR,

Its Elements,

{ *Vitriolic Acid,*
Fixt Vegetable
Alkali.

Ashes of all Vegetables,
and is formed on applying
fixt Vegetable Alkali to a
Soil, by precipitating a
Metal, or Earth, from the
Vitriolic Acid, if any Me-
talic or Earthy Salt be con-
tained in the Soil; or by
attracting the Vitriolic Acid
from the Air.

GLAUBERS SALT,

Its Elements,

{ *Vitriolic Acid,*
Fixt Fossile Alkali.

It is found native in Mi-
neral Waters.

It is produced by the
Burning of a Vegetable
containing Sea Salt, and is
found in its Ashes.

found in Soils are,

of any Elementary Salt, with any other
perties of a Salt.

and Alkalies found in Soils, are,

Their PROPERTIES.

It is difficultly soluble in Water, requires a
great Quantity of Water to dissolve it, and re-
mains dry in the Air.

It dissolves easily in a small Proportion of Wa-
ter, and dries in the Air.

SALTS

S A L T S

N A M E S.

The Manner in which they
are found or produced.

N I T R E.

Synonima,

Salt Peter,

Elements,

{ *Nitrous Acid,*

{ *Fixt Veget. Alkali.*

It is formed by applying
fixt Vegetable Alkali to a
Soil, it precipitating Vola-
tile Alkali, Calcareous
Earth, or Magnesia, from
the Nitrous Acid.

C U B I C N I T R E.

{ *Elements,*

{ *Nitrous Acid,*

{ *Fixt Fossile Alkali.*

It is formed by applying
fixt Fossile Alkali to a Soil,
as common Nitre.

N I T R O U S A M M O N I A C.

Elements,

{ *Nitrous Acid,*

{ *Volatile Alkali.*

It is produced by the last
Stage of Putrefaction.

found in Soils are,

Their PROPERTIES.

It remains dry in the Air, and deflagrates with any inflammable Matter.

Properties the same as Common Nitre.

It attracts Water from the Air, it deflagrates with any inflammable Matter, or upon being heated red Hot.

F

SALTS

NEUTRAL SALTS

NAMES.

The Manner in which they
are found or produced.

DIGESTIVE SALT of

SYLVIVS.

Elements,{ *Muriatic Acid,*{ *Fixt Veget. Alkali.*

It is formed by applying fixt Vegetable Alkali to a Soil, containing any Ammonical, Earthy, or Metallic Salt, with the Muriatic Acid; the fixt Alkali, separating the Volatile Alkali, Earth, or Metal, from the Acid.

COMMON SALT.

*Synonima,**Common Sea Salt,*

Which is impure, containing Salts with

*Magnesia.**Bay Salt,**Sal Gem,**Elements,*{ *Muriatic Acid,*{ *Fixt Fossile Alkali.*

It is found Naturally in the Earth, and in almost all Spring Waters; hence almost every Soil contains it.

COMMON SALAMMONIAC.

Elements,{ *Muriatic Acid,*{ *Volatile Alkali.*

It is formed by Putrefaction, and is also found in Soot.

found in Soils are,

METALLICK SALTS, or Compounds of
Their PROPERTIES

The Manner in which they
It remains dry in the Air.

GREEN VITRIOL. It is formed by the De-
composition of Iron, or
is found in Mineral Wa-
ters.

It remains dry in the Air.

EARTHY SALTS, or Compounds of Acids

It remains dry in a dry Air.

S A L T S

METALLICK SALTS, or Compounds of

N A M E S.

The Manner in which they
are found or produced.

GREEN VITRIOL.

Elements,
{ *Vitriolic Acid,*
 Iron.

It is formed by the De-
composition of Pyrites, or
is found in Mineral Wa-
ters.

MURIA FERRI.

Elements,
{ *Muriatic Acid,*
 Iron.

It is found in Mineral
Waters.

EARTHY SALTS, or Compounds of Acids

SELENITES.

Synonima,
Gypsum,
Paris Plaister.

Elements,
{ *Vitriolic Acid,*
 Calcareous Earth.

It is found Native.

It is formed by Expo-
sure of Calcareous Earth
to the Air, from which it
attracts Vitriolic Acid,
and is also formed by the
Precipitation of Magnesia,
Earth of Alum, or Metals
from Vitriolic Acide by
Calcareous Earth.

found in Solids are,

Acids and Metals.

are found or produced.

Their PROPERTIES.

It coagulates Vegetable Juices, and hardens their Solids.

It coagulates Vegetable Juices, and hardens their Solids.

and Earths, are

It requires a very large Proportion of Water to dissolve it, is with difficulty soluble in Water, and remains dry in the Air.

EARTHY

EARTHY SALTS

NAMES.

The Manner in which they
are found or produced.

NITROUS SELENITES, It is formed by Putrefac-
tion.

Elements,

Nitrous Acid,

Calcareous Earth.

LIQUID SHELL.

Synonima,

It is found Native, and
formed by Putrefaction.

Fixt Ammoniac,

Elements,

Muriatic Acid,

Calcareous Earth.

EARTHY

found in Soils are,

Their PROPERTIES.

It deflagrates, and attracts Water from the Air.

It attracts Water from the Air.

EARTH

EARTHY SALTS

NAMES.	The Manner in which they are found or produced.
--------	--

MAGNESIA
GLAUBER'S
SALTS.

Synonyma,

*Epsom Salt, and the
purging Salt of most
Mineral Waters.*

Elements,

{ *Vitriolic Acid,*
{ *Magnesia.*

MOTHER OF NITRE.

Elements,

{ *Nitrous Acid,*
{ *Magnesia.*

It is found Native in
Soils, and very frequently
in Spring Waters, and it
is produced by exposing
to the Air, any Neutral
Salt, containing Vitriolic
Acid, dissolved in a large
Proportion of Water, to
the Air.

It is produced, by the
Exposure of a Solution
of any Neutral Salt, (con-
taining Nitrous Acid) in
a large Proportion of Wa-
ter, to the Air.

[41]

found in SOILS are,

Their PROPERTIES.

It attracts Water from the Air.

It deflagrates with any inflammable Substance,
and attracts Water from the Air.

G

SALTS

S A L T S

N A M E S.

The Manner in which they
are found or produced.

MURIA MAGNESIA.

Elements,

{ *Muriatic Acid,*
 { *Magnesia.*

It is found Native, and
is produced, by the Expo-
sure of a Solution of any
Neutral Salt, (containing
Muriatic Acid) in a large
Proportion of Water, to
the Air.

COMMON ALLUM.

It is found Native, and
formed by the Exposure of
Clay, containing Pyrites, to
the Air.

ALL these SALTS prevent Putrefaction, ex-
Magnesia, is one Element; these on the other

All COMPOUND SALTS, dissolved in Water, (so
tity of Water in Proportion to the Salt,) and ex-
Neutral Salts the Alkali is converted into Magne-
an Earthy Salt. In the Earthy and Metallick
Earth, or Metal subsides, leaving the Water
Spring Water.

This Decomposition is greatly forwarded by

The *Metallick Salts* are decomposed in this
Earthy; and the *Neutral* are the slowest in their

All these Salts, except the Alkalis, tend to
late their Juices; the Metallick Salts and Allum
them, the other Earthy Salts, and the Neutral

found in SOILS are,

Their PROPERTIES.

It attracts Water from the Air.

It remains dry in the Air.

cepting those in which Calcareous Earth, or
Hand forward it.

that the Solution shall contain a very large Quan-
posed to the Air, are decomposed; viz. in the
fia, with which the Acid combines, and forms
Salts, the Acid flies off into the Air, and the
pure; hence River Water, &c. are purer than

Heat.

Manner the most readily; next to these the
Decomposition.

harden Animal and Vegetable Solids, and coagu-
most powerfully; next to these the Acids; after
Salts are least apt to have this Effect.

INFLAMMABLE Substances

NAMES.

The Manner in which they
are found or produced.

S U L P H U R,

It is found Native in the
Earth pure; or combined
with Metals, particularly
Iron, Copper, or Arsenic,
forming PYRITES; or
combined with Calcareous
Earth, or Fossile Alkali
forming *Hepar Sulphuris* in
foetid Mineral Waters.

Synonima,

Brimstone,

Elements,

{ *Vitriolic Acid,*
 Phlogiston, (i. e.
 Pure Inflammable
 Matter.)

It is found in the Ashes
of Vegetables, when they
are not burnt white, com-
bined with fixt Alkali, form-
ing *Hepar Sulphuris*.

OIL is an inflamable Fluid, not soluble in
Water. The only Oil that is ever found in Soils,
is *Fossile Oil*, and that very seldom,

found in SOILS.

Their PROPERTIES.

It decomposes upon being moistened and exposed to the Air in its pure State, and also when combined with any of these Substances, the Phlogiston flying off into the Air, and leaving the Acid, which unites with any Metal, or absorbent Earth there may be in the Soil, or with the Clay.

It is insoluble in Water.

OIL, as a Fluid not soluble in Water, would get into the Ends of the Vessels of Plants, shut up their Pores, and prevent the Absorption of the Water,

SALTS

E A R T H S

N A M E S. The Manner in which they
are found or produced.

CRYSTALLINE. It is found Native, al-
Synonyma, ways in crystals, (whole
Flint, or broke down;) or in
Sand, Masses formed from cry-
Gravel, stals.
Granitt,
Quartz,
Precious Stones.

ASBESTIS, TALC, They are found Native.
and FUSIBLE SPAR
CLAY. It is found Native.

If a Mass of it be heated red hot, it becomes
its Properties crystalline Earth.

Soap Earth agrees in its Properties with Clay,
fusible in Water, separates from it with greater
Particles.

By Culture, Clay becomes more diffusible in
It unites with Acids with great Difficulty.
Combined with Vitriolic Acid it forms Allum.
It is insoluble in Water.

found in SOILS are,

Their PROPERTIES.

It is always hard enough to strike Fire with Steel.

It is perfectly insoluble in Water and Acids.

Its Powder moistened with Water, has no Tenacity, nor does it harden when dried or heated by the Fire.

Excepting that they are softer, and more friable, they agree with chrystalline Earth in Properties.

It is soft and in fine Powder.

If it be mixed with Water, it forms a tenacious Mass, which hardens upon drying, and does not diffuse so readily in Water again as Sand. hard, and burns into a Brick, and resembles in

of which it is a Species, only it is much more difficult, is of a smoother Texture and finer

Water.

The

The Earth consists principally of Strata of these Earth are sometimes found pure, but more com-
feldomer find pure Clay, than pure Sand.

The other Earths are EXTRANEÖUS.

ABSORBENT EARTHS

NAMES.

The Manner in which they are found or produced.

CALCAREOUS EARTH.

Synonyma,

When combined
with Air.

Animal Earth,

Marble,

Limestone,

Chalk,

Marle.

When free from Air.

Quick Lime.

It would appear that the greatest Part of this Earth is produced from the Exuvie of Animals, particularly the Shells of Fishes.

It is also produced by burning Animal or Vegetable Substances; and by the last Stage of Putrefaction.

The Earth, so produced, did not subsist in the Animal or Vegetable, (except in the Bones,) but is formed by Putrefaction.

Substances, in which the Clay, and Crystalline
monly there is a Mixture of the two; and we

found in SOILS are,

Their PROPERTIES.

It may be had combined with Air when it is
called *Mild*, or free from Air when it is said to
be *Caustic*,

In both these Cases it unites with,

First, Vitriolic Acid, forming Selenites.

Secondly, Nitrous Acid.

Thirdly, Muriatic Acid, forming fixt Ammo-
niac.

It will separate any Metal, from any Acid.

Quick Lime or Calcareous Earth free from
Air, is formed from Limestone, Chalk, &c. by
exposing them to about a red Heat; the Attrac-
tion between the Earth and Air is destroyed, and
the Air driven off.

If the Calcareous Earth be mixed with any
other Substance, which has the Effect of a Flux,
a moderate Heat must only be used, as otherwise
the Surface of the Limestone would Melt, and

H

form

ABSORBENT EARTHS

NAMES.

**The Manner in which they
are found or produced.**

found in Soils are,

Their PROPERTIES.

form a Crust, which would prevent the Evaporation of the Air: This is to be known, by throwing a Piece of the Stone into a common Fire, and blowing against it with a Pair of Bellows, if there be any such Substance, the Surface will Melt.

A white Heat for the above Reason is too great to burn any Limestone with.

Calcareous Earth, produced by the burning of any animal Substance, cannot be burnt into Lime, except it be first dissolved in an Acid, and separated by an Alkali.

Quick Lime, like dry Neutral Salts, unites with Water, and Crystallizes, and the Crystals in Shooting break down the Mass, and separate from one another, so that the whole appears to fall into a fine Powder; and if one Third of the Whole consists of Lime, it is sufficient to break down the remaining Part; hence, if Limestone contain one third Part of Calcareous Earth, it may be burnt into Lime; or if it consist wholly of Calcareous Earth, and one third Part of it be burnt, it will fall down; and Lime is seldom thoroughly burnt.

ABSORBENT

ABSORBENT EARTHS

NAMES. The Manner in which they
are found or produced.

form a Crust, which would prevent the Evapora-
tion of the Air. This is the known, by drawing
a Piece of the Stone into a common Fire, and
blowing against it with a Pair of Bellows. If there
be any such Substance, the Surface will Melt.
A white Heat for the above Reason is too great
to burn any Lime-stone with.
Calcareous Earth, produced by the burning of
any animal Substance, cannot be burnt into Lime,
except it be first dissolved in an Acid, and then
raised by an Alkali.
Quick Lime, like the Neutral Salts, unites
with Water, and Cytherea, and the Crystals in
Shooting break down the Glass, and destroy them
one another, so that the whole appears to fall into
a fine Powder, and is one Third of the Whole
consists of Lime, it is sufficient to break down
the remaining Part, hence, if I imagine of contain
one third Part of Calcareous Earth, I may be
burnt into Lime; or it is consist wholly of Cal-
careous Earth, and one third Part of it be burnt,
it will fall down, and Lime is become thoroughly
burnt.

ABSORBENT

found in Slates are, & A

Their PROPERTIES & A

If Limestone contains no other absorbent Earth, except Calcareous, the Quantity of that Earth, is known by throwing one hundred Grains into an Ounce of Muriatic Acid, diluted with four Ounces of Water, letting the whole stand till there is no more Effervescence, throwing what remains into a Filter; when the Fluid has filtrated through, pouring upon what remains half a Pint of Water, letting that Filter off also, then drying and weighing what is left in the Filter, the Weight lost gives the Proportion of the Calcareous Earth.

If there be any other Absorbent Earth, upon pouring into what filtrated through two Ounces of Caustic Volatile Alkali, a Precipitation will take place; this Precipitate is also to be separated by Filtration, and its Weight deducted from the Calcareous Earth.

The Quantity of Lime burnt is known, by putting one hundred Grains into a filtrated Solution of two Ounces of Sal Ammoniac in half a Pint of Water, boiling them together in a Glass,
or

ABSORBENT EARTHS

NAMES. The Manner in which they are found or produced.

If I mention names to other absorbent Earths, excepted, I mean only the Quantity of that I intend to know by knowing the manner of finding into an Earth of that kind, and which I intend to find out. Now, among the whole world, there is no more to be found, showing what remains of a thing, when it is found, than in the Earth, being upon which remains half a pint of Water, being that of the Earth, showing and weighing what is left in the Earth, the Weight left gives the Proportion of the Calcareous Earth, and the Water, there be any other absorbent Earth, upon which it is to be found, through two Glasses, of Calcareous Earth, and Precipitation, will give the Precipitation, also to be separated by filtration, and its Weight deduced from the Weight of the Earth, which is called the Quantity of the Earth, is known by putting one hundred Grains into a filtered Solution of two Glasses of distilled Water, and a pint of Water, boiling, and separating in a Glass, and it will show in Water.

Now, I have shown in Water in the Proportion of about five Grains to a Pint.

ABSORBENT

found in Soils are,

Their PROPERTIES.

or Stone Vessel, for an Hour, or until there is no smell of Volatile Alkali; taking Care to add Water as the former Evaporates; afterwards filtrating what remains; after the Filtration, pouring upon what is in the Filter, half a Pint of Water, letting that Filter off also; then drying and weighing what remains in the Filter, the Weight lost is the Lime burnt.

If Calcareous Earth is found in a loose Mass, so as to break down very readily, it is with Difficulty burnt into Lime, as the Fuel can hardly burn if mixed with it; and if it is mixed with Clay, it will burn into a Brick, which will both prevent the Evaporation of the Air, and the falling of the Lime; in both these Cases it is called Marle.

Calcareous Earth when mixt with Clay, gives a greater Friability to it than Sand does; hence Marle falls easily down in Water.

Quick Lime dissolves in Water in the Proportion of about five Grains to a Pint.

ABSORBENT

ABSORBENT EARTHS

NAMES. The Manner in which they are found or produced.

or Stone Vessel for an Hour, or until there is no smell of Volatile Alkali; taking Care to add Water as the former Evaporates; afterwards stirring what remains; after the Filtrate, pouring upon what is in the Filter, half a Pint of Water, turning the Filter off also; then drying and weighing what remains in the Filter, the Weight lost is the Alkali form.

If the absorbent Earth is found in a loose Mass, it is to be calcined very readily, and with Diffculty, being into Lumps, as the Fuel can hardly burn it exposed without, and it is mixed with Clay, it will burn into a brick, which will both prevent the Evaporation of the Air, and the falling of the Lumps, in both these Cases it is called *Malle*.

Calcineous Earth when mixed with Clay, gives a greater Elasticity to it than Sand does; hence it is called down in Water.

Quick Lime dissolves in Water in the Proportion of about five Grains to a Pint.

ABSORBENT

found in SOILS are,

Their PROPERTIES.

It unites with Sulphur, forming *Hepar Sulphuris*.

It unites with Animal and Vegetable Substances, forming a Soap.

It prevents Putrefaction.

It attracts Acids stronger than Volatile Alkali or Magnesia.

If it be exposed to the Air, it attracts from it the fixable Air, and reverts to the State it was in before it was burnt.

Mild Calcareous Earth, forwards Putrefaction.

It is insoluble in Water.

When Calcareous Earth is reduced to a Powder, and applied to a Soil, it is apt to be washed through it.

Caustic Volatile Alkali will not precipitate Calcareous Earth, if dissolved in an Acid; but fixt Vegetable Alkali will; this distinguishes it from the other Earths.

Vitriolic Acid will not dissolve it so as to form a clear Solution; and if this Acid be added to a Solution of it in any other, it will make a Precipitation.

I

ABSORBENT

ABSORBENT EARTHS

NAMES.

The Manner in which they are found or produced.

MAGNESIA.

It is produced by the Decomposition of any Salt containing Magnesia, by Exposure to the Air, or applying to it an Alkali, or Caustic Calcareous Earth.

EARTH of ALLUM.

It is produced by the Decomposition of Allum.

found in SOILS are,

Their PROPERTIES.

It may be had combined with Air or free from Air.

In both Cases it unites with

First, Vitriolic Acid, forming Magnesia Glauber's Salts.

Secondly, Nitrous Acid.

Thirdly, Muriatic Acid.

It is insoluble in Water.

It assists Putrefaction.

It may be had free from Air, or combined with Air.

In both Cases it unites with Vitriolic Acid, forming *Allum*.

A I R S.

A I R is a V A P O U R not condensible in
bination.

A I R is of several Kinds, *Viz.*

N A M E S.

The Manner in which they
are found or produced.

RESPIRABLE AIR.

FIXABLE AIR.

INFLAMMABLE AIR.

There are also several other Kinds of Air.

A I R S.

the Heat of the Atmosphere without Com-

Their PROPERTIES.

That which serves for the Life of Animals and Vegetables, and Inflammation of Fuel.

That which is contained in Alkalis, and Absorbent Earths when they are Mild. It will neither serve for the Respiration of Animals, nor Vegetables, nor the Inflammation of Fuel, but it is not poisonous.

Separates from Metals while they combine with Acids, is often found in the Earth near Mines, and is poisonous.

Animal

Animal and Vegetable SUBSTANCES

N A M E S. The Manner in which they
are found or produced.

ANIMAL FIBRES.

VEGETABLE FIBRES.

VEGETABLE and ANI-
MAL MUCILAGENOUS
JUICES.

BITTER, ASTRINGENT,
RESINOUS, &c. JUICES
OF VEGETABLES.

found in SOILS are,

THEIR PROPERTIES.

Dissolved in Water, form a Solution, which
Jellies.

They form when dissolved in Water, a Solution
which is Gummy.

They form a gummy Solution in Water, but
if putrified, a Gelatinous one.

They prevent Putrefaction.

Animal

Animal and Vegetable SUBSTANCES

NAMES. The Manner in which they are found or produced.

MUCILAGE. It is produced by the Putrefaction of Animal or Vegetable Substances, and is applied to Soils in

First, The Dung of Animals.

Secondly, Putrid Animal or Vegetable Fibres or Juices.

Thirdly, The Roots of Plants, if they putrify in the Soil.

Fourthly, The Exsudation from the Roots of the Plants, growing in the Soils, if it putrifies.

Fifthly, The Insects in Soils, if they putrify,

Sixthly, The Dung of the Insects.

Seventhly, The Animal and Vegetable Substances contained in Rain Water and Dew, if they putrify.—There are two Stages of Putrefaction, the first produces Mucilage, the second converts it into Calcareous Earth, Muriatic and Nitrous Acids, and Volatile Alkali.—Vegetable Substances, before they putrify, go thro' the Sacharine, Vinous, and Acetous Fermentations, but Animal Substances putrify immediately.—Two, or more of these Fermentations, may go on in the same

found in Soils are,

Their PROPERTIES.

Gives Viscidity to a large Proportion of Water.

It prevents the Evaporation of Water.

It gives Tenacity to Sand, and Friability to Clay.

It cannot be separated from Water by Filtration.

K

Animal

Animal and Vegetable SUBSTANCES

NAMES. The Manner in which they are
found or produced.

same Mass, at the same Time ; as for Example ; What is already converted into Wine, may be converted into Vinegar, while another Portion of the Mass is converting into Wine.—The Sacharine, Vinous, and Acetous Fermentations, generate Heat, but the Putrefactive does not.—In order that any Substance should be formed by a Fermentation perfectly, it is necessary that the Operation go on neither too fast, nor too slowly.—The Substances forwarding Putrefaction increase the Quantity of Mucilage, by making Animal or Vegetable Matters putrify, which would either not have putrified at all, or which should have putrified too slowly. But they also tend to destroy it, by making the Mucilage proceed to the second Stage of Putrefaction, and so convert it into Earth and Salts.

They tend more to forward the first, than the second Stage of Putrefaction.

found in SOILS are,

Their PROPERTIES.

P A R T III.

The STRUCTURE and OECONOMY of
VEGETABLES, necessary to be known
in AGRICULTURE.

THE principal Vessels of Plants are of two
Kinds, *Tubes* and *Cells*.

The TUBES run from the Roots to the
different Parts of the Plant in separate Bundles,
communicating with one another, but not join-
ing and branching, as in Animals.

These Tubes contain principally the mucilagi-
nous and saccharine Juices, serving for the Nou-
rishment of the Vegetable.

The Tubes being capillary, if empty, and
emersed in Water, or any other Fluid, have a
Power of filling themselves by the Attraction of
their Sides to the Fluid; but this will not by any
means

means account for the Circulation in Vegetables: There is therefore a Power similar to the muscular Power in Animals, by which this Motion (at least in Part) and all the other Motions of Vegetables are performed.

The CELLS contain the peculiar Juices of Plants, and most probably these are formed in them by Fermentation: They communicate with the Tubes, or rather the Tubes terminate in them.

In the Root of a Plant the Cells surround the Tubes, which are only open at the extreme Points of the Fibres, and Fluids cannot be absorbed by them any where else.

The Tubes are not simply open at the End of the Fibres, but there is a particular Configuration, which adapts them to absorb Fluids; so that if the Ends of all the Fibres of the Roots of any Vegetable be cut off, the Growth of that Vegetable is stopped, till fresh Fibres are formed.

Unless there be a Number of Fibres in the Root, a Plant will seldom flourish, inasmuch as a sufficient Quantity of Nourishment cannot be absorbed.

More numerous Fibres may be made to break out by

A suf-

A sufficient Tenacity in the Soil;

Richness of Soil;

Cutting the Fibres; in which case they do not go on, but branch out into new ones;

Poisoning the weak Fibres, and

Cutting the Branches.

But the Fibres are rendered too weak for the Support of the Plant, by

Too great a Tenacity of the Soil;

Applying Poison in too great a Quantity; and

Cutting the Branches too much.

As Roots can only absorb Nourishment from the Points of their Fibres, the Cells surrounding them serve to defend the Tubes from Water, which they do, if the Soil be moderately dry; but in very moist Soils, the Water soaks through to the Tubes, stops the Circulation in them, and rots them.

The Roots of some Plants will bear a much greater Quantity of Moisture than those of others.

In Trees and Shrubs, the Stems, which are above a Twelvemonth old, are to be considered as Roots, having the same Structure.

At that Part where the Root is converted into a Stem, the Tubes devaricate, and are placed on the Outside; being covered only with a thin Bark, which is of the same Texture, and answers the Purposes

Purposes of the Leaves, the Cells forming the Pith, being contained in the middle.

Water constantly evaporates from the Leaves and the Bark of the Stem, and carries along with it the volatile Parts of the Juices, and some small Portion of the more fixed; but they attract Water from the Atmosphere at the same time, so as in some Cases to nourish the Plant totally, and the Roots also throw out a Part of the Juices into the Ground.

There is a considerable Difference betwixt that which evaporates into the Air, and that which exsudes into the Ground; as the former contains Water with the essential Oil of the Vegetable, and the latter the mucilaginous Juices.

The Exsudation from the Roots takes Place in the greatest Quantity,

First, While the Leaves are flourishing, hardly any thing flowing out after they begin to decay.

Secondly, In Plants that are moderately succulent.

Thirdly, In perennial Plants, at the Time of the Flowing of the Sap.

Of the GROWTH of PLANTS.

A SEED consists of

The HUSK, a Membrane covering the other Parts.

The

The COTYLEDONS, one, two, or three Masses of farinaceous Matter.

The EMBRYO (i. e.) the young Plant, consisting of a *Radicle* and *Plumule*.

The EMBRYO lies in a dormant State (i. e.) alive, but not exerting its Life, until it is put in proper Circumstances; which are

of { Heat,
Moisture, and
Exposure to the Air.

It requires different Degrees of these to make different Seeds grow.

First, If a Seed once begins to grow, and is stopped, the Embryo dies.

Secondly, The Embryo may also die from Age (i. e.) if the Seeds are kept too long; and in some Seeds, this happens in twelve Months, in others not in twelve Years.

Thirdly, Or it may be destroyed by Insects.

Fourthly, Or it may undergo Fermentations from Moisture.

Fifthly, Or it may be killed by Poisons.

In all these Cases the Vegetation of the Seeds is destroyed.

When a Seed is put in the proper Circumstances for growing, the farinaceous Matter in the Cotyledons is converted into Sugar, the Embryo swells, and the Radicle pushes forwards,
till

till it gets through the Husk, and afterwards runs perpendicularly downwards, till it breaks out into Fibres.

These Fibres run in different Directions, but never penetrate above a certain Depth from the Air.

The PLUMULE, when the Radicle has got into the Earth, rises upwards; sometimes bringing along with it the Cotyledons, which are in some Cases converted into the Seed Leaves.

During this Time the Plant is nourished principally by the Cotyledons; for if the Root be destroyed, the Plumule will rise up, and when it gets above Ground, and its Leaves spread, fresh Roots will be thrown out.

If a Plant be cut off below the Cotyledons, it will hardly ever push out fresh Leaves, but it rots, and is destroyed; on the other hand, if it be cut off above the Cotyledons, it generally shoots afresh, and continues to grow; therefore, if Plants, whose Cotyledons come above Ground, as Turneps, be cut, or eat to the Ground by any Animal, they decay; but if such, whose Cotyledons remain below Ground, (the Grasses for Example) are cut, they will shoot out afresh.

From

L

After

After the Plumule is come above Ground in the Grasses, there is a Knot or Swelling formed above the Cotyledons, where the Stem divides into, or throws off, several Branches and fresh Roots; and as soon as the Leaves of these spread, the first Root dies. This is called *Tillering*.

These Branches are more or less numerous, according to

The Richness of the Soil;

The Tenacity of it;

The Room the Plant has to grow in;

The Moisture of the Soil; and

The Earliness of the Season.

Each of these Branches may be made to divide a second Time,

By sowing the Seed early in the Autumn; it in this Case branching out in the Autumn, and again in the Spring;

By cutting the Stem;

By cutting the Roots;

By Transplantation;

By great Moisture in the Soil; hence Corn, after it has flowered, will sometimes branch out a second Time after heavy Rains.

If a Grass be made to branch out a second Time, in a poor Soil, or a dry Season, the Branches are apt to run up weak.

Most

Most perennial Plants (excepting Trees and Shrubs) become so by branching out afresh every Autumn, the old Roots and Plants dying.

ROOTS push forward with considerable Force, which however is not equal in all Parts; and a sufficient Resistance stops them, and makes them branch out laterally.

If the Resistance from the Tenacity of the Soil be too great, they break out into a vast Number of Branches, too weak to support the Plant; and if too little, they run out into long Fibres, having too few Ends or Mouths to absorb sufficient Nourishment.

The Root always runs where there is the least Resistance.

The STEMS go on flourishing more or less, according to

First, The Moisture of the Soil;

Secondly, The Heat;

Thirdly, The Soil's being adapted to the Roots;

Fourthly, The Richness of the Soil, and its Freedom from noxious Substances;

Fifthly, The Time the Seed has been kept, viz. the shorter the Time it has been kept, the more luxuriant the Plant.

The STEM pushes out from it the FLOWER-STEM, which arises either laterally as the Leaves spread, as in Peas; or terminates the Stem: And in this Case either there is only one, as in Grasses; or several, as in Turneps and Cabbages.

When the Flower-Stem arises laterally, the Leaves continue to flourish after the Flower is dropped off, and of consequence until the Seed is perfected, and the whole Plant dies; but when the Flower-Stem is terminal, the Leaves begin to wither as soon as the Flower drops off. Hence, as the Nourishment is taken entirely from the Ground, without any Exsudation of any thing imbibed from the Air into it, after this Period, Grasses and other Plants having terminal Flowers, enrich the Soil till they flower; but afterwards impoverish it, perhaps in some Degree in Proportion to the Weight of the Seed.

In Grasses no new Leaves spring out from the Stem after the flowering; and those which have already sprung out, begin to lose their Juices, and decay.

GRASS should therefore be cut for Hay as soon as it is fully in Flower. Different Grasses flower sooner or later; therefore if two Grasses grow on the same Field, either one or other must be cut too soon or too late,

All

All Plants have Male and Female Parts of Generation; the *Chives*, or Male Part; the *Pistil*, or Female Part.

The **CHIVES** are Bags, containing a Powder; they open just as the Flower opens, and the Powder impregnates the Female Part.

This Impregnation is prevented,

First, By Cold;

Secondly, By very violent Rains;

Thirdly, By Weakness of the whole Plant;

Fourthly, By Weakness of the Roots; so

that in moist Soils, or very rainy Seasons, when

the Plant appears to be flourishing greatly, and

a sufficient Quantity of Flowers are thrown out,

the Impregnation does not take Place, and the

Seed or Fruit either drops off entirely, or is small

and shrivelled, the Roots being rotted by the

Moisture.

Fifthly, By the Want of Air.

When the Leaves and Stem of a Plant flourish

greatly, it seldom produces many Flowers.

In Grasses, as the Nourishment is drawn from

the Roots after they flower, if the Roots are

rotted by Moisture, the Seeds will not be per-

fected: In the ripening of the Seed, the farina-

ceous Part of the Cotyledon is produced.

Plants

Plants cannot live without AIR; it answers probably the same Purposes to them that it does to Animals.

The Action of the Air appears to be principally on the smooth Surface of the Leaves, or the Bark of the Stem.

The Air is rendered effete by the Plant; so that there must be a continual Supply of fresh Air, otherwise the Stem runs out to a great Length, is exceedingly small and weak, the Leaves endeavour to spread out to a great Distance, no Impregnation takes Place in the Flowers, the proper Juices are not formed, and the whole Plant is destroyed.

Hence, if several Plants are sown in a Soil, those which are best adapted to it will grow up strongest, rob the others of the Air, and destroy them.

The Roots also require Air; so that if a Root be planted too deep, it will not grow, and different Roots require also different Degrees of Exposition.

It is only respirable Air that will answer these Purposes.

LIGHT is also necessary for the Growth of a Plant, but not so much so as Air.

Most Leaves have two Surfaces, one of which is always exposed to the Light; and if the other
is

is turned to it (by altering the Position of a Branch) the Growth is frequently stopped, until the Leaves turn themselves to it again.

This smooth Side of the Leaf therefore, being that which is acted upon by the Air and Light, would appear to be that Part by which a Plant principally lives; and in many Plants the Leaves shut themselves up, so as to cover this smooth Side on Exposure to cold Air, noxious Vapour, Darkness, or even upon being touched.

The Want of a sufficient Quantity of Light, prevents the Plant from forming its proper Juices (except Mucilage and Sugar), deprives it of its Blue Colour (the Green consisting of Blue and Yellow), leaving it either Yellow or Colour-less, makes it run up weak, and prevents the Impregnation of the Seeds.

Want of a sufficient Quantity of Air and Light, more especially prevent the Impregnation of the Seeds.

HEAT in a moderate Degree, according to the Disposition of the Plant, makes the Leaves flourish, and the Stem strong, provided the Soil is sufficiently moist; in a very great Degree it makes the Plant run up to Seed too soon, especially in a dry Soil, and prevents the Growth of the Leaves.

Heat

Heat also prevents Moisture from rotting the Roots, or any other Parts of a Plant; but it increases the Effects of most other Poisons.

Plants are subject to HABITS, the principal of which are,

First, The Seed's growing early in the Spring, and the Stems pushing up soon to Flower, and producing but a few Flowers: This is acquired by their having been propagated in a dry, sandy, warm Soil.

Secondly, The Seed growing late, being long of pushing up the Stem, so that there is often not Time for the Seed to ripen: This is acquired by their having been propagated in a moist, stiff, cold Soil.

Thirdly, A Disposition to grow exceedingly strong in all its Parts; in which Case too few Flowers are often produced: And this is acquired from their having been propagated in a very rich Soil.

Fourthly, Its Disposition to grow weak, and produce small Seeds, acquired from being propagated in a poor Soil.

These affect the Grasses particularly, so that it is frequently useful to change the Seed.

P A R T IV.

Of the NOURISHMENT of PLANTS.

A PLANT will grow in Sand alone, moistened with pure distilled Water, and in the purest Air, but not so luxuriantly as in a rich Soil.

A Plant will also grow better in a Mixture of Sand and Clay, where the Tenacity is adapted to the pushing Power of its Root, than in Sand alone; and it will also grow better if a proper Quantity of Water be applied, [according to the Disposition of its Roots to resist Putrefaction, but with both these Advantages, it will not flourish so well as in a rich Soil.

If in a proper Mixture of Sand and Clay, a Plant is properly supplied with Water, it will

M

grow

grow better than in the same Mixture exposed to the Weather, and the Chances of being too moist or too dry; but it will grow still better in a rich Soil.

There is therefore in a rich Soil something independant of Texture, or the Retention of Water, which contributes to the flourishing of Plants.

A Rich Soil contains Substances insoluble in Water; or Substances soluble in Water.

The Substances insoluble in Water cannot enter the Vessels of the Roots of Plants, and therefore can only contribute either to the Texture, or the Production of Substances soluble in Water.

The Substances insoluble in Water may necessarily only be Sand or Clay; those at any Time found are,

Sand;

Clay;

Asbestos Talc; &c.

Calcareous Earth;

Magnesia;

Earth of Allum;

Calces of Metals; particularly Iron and Copper; and

The Fibres of Vegetables.

Those

Those soluble in Water that are found in all rich Soils, are

Mucilage;
Nitrous Ammoniac;
Nitrous Selenites;
Common Ammoniac;
Fixt Ammoniac;

These Substances all get into the Plant along with the Water; and the Salts are found in the Juices of the Plant, unchanged.

A Mucilage is also found, but very different from that contained in Soils.

Therefore a Plant may be nourished by pure Water and Air alone; but it will be more luxuriant, if it also absorbs, and digests, a Quantity of Gelatinous Mucilage.

RICHNESS of the Soil depends on

First, A proper Degree of Tenacity, which is procured by

(a) A Mixture of Clay with Sand, or any other Earth, so that it shall contain between one Fourth of Clay, and three Fourths.

(b) Mucilage, which gives Friability to the Clay, and Tenacity to Sand.

(c) The Quality of the Clay, the more diffusive it is in Water, it gives the better Texture to the Soil.

M 2

Secondly,

Secondly, The Quantity of Mucilage, the more there is in a Soil, the better.

One Grain in a Thousand will be of Advantage, as it will give a sensible Tenacity to a sufficient Quantity of Water, to moisten the Soil thoroughly.

Thirdly, The Quantity of Substances capable of being converted into Mucilage.

(Vide Mucilage, Page 42.)

Fourthly, The Matters in the Soil disposing these to be converted into Mucilage.

These are,

Calcareous Earth,

Earthy Salts.

If a Soil be Rich, a small Proportion of an Alkali, Neutral Salt, Caustic Calcareous Earth or Earthy Salt (except the Salts of Allum) will improve it, but these Substances unless they be Putrescents, hurt Plants growing in a poor Soil.

These Substances may be said to be *forcers*, in as much as they not only tend immediately to produce a larger Crop, but destroy the Mucilage.

They may act by destroying the weak Fibres of the Roots, and occasioning them to push out more numerous and stronger Ones.

They may prevent the Evaporation of the Water.

They

They may destroy Insects.

Possibly, they may assist the Digestion of the Plant.

A very small Proportion of them, produces an Effect.

In manuring poor Soils, we are therefore to render them of a proper Texture, by adding Clay or Sand, where it can be done sufficiently cheap, taking care that they be free from Pyrites, and it is to be observed, that less Clay will be useful in sandy Soils, than Sand in Clay Soils.

FROST by the expansive Power of the Crystallization of the Water, breaks down the Masses, which form in stiff Soils.

We are to apply Gelatinous Mucilage, or Substances from whence it may be formed, or Substances forwarding the Formation of it.

(Vide Mucilage, Page 42.)

These are enriching Manures.

And in rich Soils, we may venture to apply the forcing Manures, as otherwise we should not have the whole Effects of the Mucilage.

Any Defect of Texture may be made up by Mucilage, and the Alteration Clay undergoes on Culture, but the Defect of Mucilage cannot be made up by Texture.

A Soil

A Soil, if it have all the Properties of a rich one, may have these counteracted by its containing poisonous Substances, which are,

First, Metallic Salts, or Pyrites.

Secondly, Salts containing Earth of Allum, (or Pyrites.)

Thirdly, Acids uncombined.

Fourthly, Any other Salt in too large a Proportion.

The first, second and third may be destroyed by Quick Lime; the fourth is got the better of by Time, and the Washing the Soil with Water, by the Rains, unless there be a fresh Supply from Springs.

The Advantages of draining a Soil, are the preventing the Water from

Rotting the Seeds,

Rotting the Roots, especially at the Time of flowering.

Taking off the Effects of the Mucilage, by too great Dilution.

The Advantages of FALLOWING are,

The Conversion of the Vegetable Fibres into Mucilage, by destroying their Life, and exposing them to the Air.

The

The destroying Weeds, by giving their Seeds an Opportunity of growing, killing them, and converting them into Mucilage.

The decomposing Pyrites, and Metallic and Alluminous Salts.

A very poor Soil will be but little benefited by Fallowing, in as much as there is nothing contained in it capable of being converted into Mucilage, except the Rain Water, it is better to employ an enriching Crop.

Fallowing for several Years would destroy a Soil, as it would convert the whole putrescent Substances into Mucilage, and that Mucilage into Salts, and these would be decomposed.

The Advantages of DRILLING are,

The giving an Opportunity to destroy the Weeds, cut the Fibres of the Roots so as to make them branch out again, and loosen the Earth about the Roots, and throwing the Earth on the Stems, so as to make fresh Roots break out.

The saving superfluous Seed and sowing the Ground more equally.

The giving a free Passage to the Air.

It is not yet determined how far the Rows should be from one another, nor how thick the Plants should be sown; it will require that they should be sown thinner to produce a great Crop
of

of Seeds, or Roots, than a great Quantity of Herbs.

Quere, Is there any Difference in the Direction of the Rows?

Enriching Crops are such as supply the Soil with Matters capable of being converted into Mucilage, they do this

First, By Exsudation from the Roots,

Secondly, By leaving the Roots, which will Putrify.

Thirdly, If ploughed in, the whole Plant will Putrify; and it is to be observed in this Case, that the Plants should always be cut down when in full Vigour, and while the Exsudation is still taking Place strongly.

If the Juices exsuded are very astringent, they counteract the good Effects of this Method of Culture by preventing the Putrefaction.

A List of M A N U R E S.

First, Those furnishing Mucilage or Substances convertible into it.

As, Glue,

Skins,

Hair,

Hornes,

Bones,

Rags,

Rags, &c. &c.

Dung of Animals,

Insects,

Vegetable putrified Substances; these go through the Sacharine, Vinous, and Acetous Fermentations first; so that a Dunghill is not sufficiently putrified, until the Heat is over; but it is better to putrify too little, than too much, as in the first Case, the Putrefaction may be continued in the Soil; in the second, the Mucilage is converted into Salts, and cannot be restored.

Putrescible Vegetable Substances: It is to be observed that Vegetable Substances that are of too solid a Texture, as Wood, putrify with great Difficulty into a Mucilage, and also those that have astringent Juices, and such as have lain in the Earth a considerable Time, and Sugar.

Enriching Crops.

Secondly, Manures converting putrescible Substances in to Mucilage.

Calcareous Earth, as

Marle,

Chalk,

Effete Lime :

Earthy Salts, in

The Dung of Fowls, Rabbits, &c.

N

Too

Too putrid Dunghills,
Sea Water in small Quantity,

Thirdly, Forcing Manures, as,

Quick Lime,

Fixt Alkalis in Vegetable Ashes,

Neutral Salts which do not assist Putrefaction,

Earthy Salts as above.

OF I N S E C T S.

There are some Insects which infest Vegetables when healthy, as the Insect occasioning the Smutt, or Blackness, in Grain; this Insect is not destroyed by drying, but revives upon being moistened, and if sown with the Seeds, will be propagated over the whole Field.

Q. Is this to be destroyed by steeping the Seeds in Solutions of Neutral Salts in Water?

Most Insects attack Plants, in Consequence of a Weakness of the Plants themselves; the Juices in that Case being converted into Sugar, become proper Nourishment for, and attract them, but when this happens, they afterwards hurt the Plant greatly.

Each Plant is infested by its particular Insects.

P A R T V.

SUBSTANCES necessary for the
Examination and Analysis of SOILS,
 are,

FIRST, Vitriolic Acid,

Secondly, Muriatic Acid,

Thirdly, Solution of fixt Vegetable Alkali in
 Water.

Fourthly, Common Caustic, or Caustic fixt
 Vegetable Alkali.

Fifthly, Caustic Volatile Alkali, or Spirit of
 Sal Ammoniac with Quick Lime; it is known
 to be Caustic by not effervescing with an Acid.

Sixthly, Sal Ammoniac.

Seventhly, Galls.

Eighthly, Pure Water; if the Water contain
 any Metallic or Earthy Salt it is improper; to
 try this, pour into a Glass of it a few Drops of

Solution of fixt Vegetable Alkali in Water; if it be impure, the Alkali will precipitate the Metal or Earth; such Water is to be purified by Distillation or Boiling.

PROCESSES for ascertaining the Substances contained.

Process First, To ascertain the Quantity of Water.

Take one hundred Grains of the Earth, spread it on a Stone Plate very thin before the Fire, or in the Sun-shine in a warm Day, let it lie till it be thoroughly dry, the Water will evaporate, and therefore its Proportion will be known by the Weight lost.

Secondly, To know if there be any Metallic or Earthy Salt.

Take about a Pound of Soil, pour upon it about a Pint of boiling distilled Water, stir them thoroughly together, and let them stand for ten Minutes, filter off the Water through filtering Paper, pour into what comes through a little of the Solution of the fixt Vegetable Alkali in Water, if there be any Earthy or Metallic Salt, a Precipitation will take Place.

Thirdly, To know if the Salt contained has Calcareous Earth for one of its Elements.

Take the filtrated Solution, pour into it half an Ounce of Caustic Volatile Alkali, or continue
to

to drop in this Alkali till no further Precipitation takes Place, afterwards filtrate it, and pour to what filtrates through, a little Solution of fixt Vegetable Alkali, if there be any further Precipitation, it shows that there is an Earthy Salt consisting of Calcareous Earth for one of its Elements; if a Precipitation took Place upon the Application of the Caustic Volatile Alkali, it shows that there are either other Earthy or Metallic Salts.

Fourthly, To know if the Salt contained be Metallic or Aluminous.

Add to the filtrated Solution an Infusion of Galls, if there be any Metallic or Aluminous Salt, a Precipitation will take Place, if Iron a purplish Black, if Copper, or Allum, a Grey.

Copper may also be distinguished from Iron by falling in a blue precipitate upon the Application of an Alkali, while Iron forms a Greenish, and Allum a White one.

Fifthly, To know if Magnesia be an Element of the Salt found.

Take the filtrated Solution, apply to it a Solution of Galls; if no Precipitation take Place, apply Caustic Volatile Alkali, which will precipitate the Magnesia if it be an Element of the Salt contained,

Sixthly,

Sixthly, To know if a Neutral Salt be contained.

Evaporate the filtrated Solution with a boiling Heat, till the whole Water is nearly gone off, and let it stand to cool. If there be any Neutral Salt, it will crystallize.

Seventhly, To know if there be any Mucilage and what Quantity.

Take thirty or forty Pounds of the Soil, boil it in ten Gallons of Water for an Hour, let the Earth subside, pour off the clear Solution, afterwards add four or five Gallons of Water to the Earth, stir them thoroughly, let them stand to subside, pour off the Water clear, mix it with the former, and evaporate the whole to dryness, putting it into a Water Bath towards the End of the Evaporation, what remains is the Mucilage, making Allowance for that part of the Decoction which was not washed out from the Earth, and deducting the Saline Substances which will crystallize if there be a considerable Quantity, but will be destroyed in the Operation if in small Proportion, as they generally are.

Eighthly, To know if there be any Calcareous Earth in the Soil, and what Quantity.

Take one thousand Grains of the dry Soil, apply to it half an Ounce of Muriatic Acid and four Ounces of Water in a Glass, Stone Ware, or Porcelaine Vessel, sufficiently large; let them stand

stand together till no more Effervescence takes place; and if it was very considerable, pour in half an Ounce more of the Acid, let this stand also till the Effervescence ceases, if any arose upon pouring it in, continue to add more Acid in the same Manner, until what was poured in last, produces little Effervescence, which is often at the first, and generally at the second or third half Ounce.

After the Effervescence has ceased, put the whole in a Filter, let the Solution filtrate through; pour half a Pint of Water upon what remains in the Filter, let that filtrate also into the same Vessel; add to the Solution thus filtrated an Ounce and an Half of Caustic Volatile Alkali for every Ounce of Acid used; if any Precipitation take Place, there is Magnesia, Earth of Allum, or the Calx of a Metal (generally Iron or Copper) contained in the Soil; after adding the Volatile Alkali the whole is to be thrown into a Filter again, after the Filtration has taken Place, pour into the Liquor a Solution of mild fixt Vegetable Alkali in Water, if there be any Calcareous Earth in the Soil, a Precipitation will take Place; continue to add the Solution of the Alkali till no fresh Precipitation ensues, throw the whole into a Filter, let the Liquor filtrate off, pour on by Degrees

grees a Pint of Water, let that filtrate off also, dry what remains in the Filter, it is the Calcareous Earth.

Ninthly, To know the Proportions of Sand and Clay.

Take what remains in the Filter after the first Solution in the foregoing Operation, and by Elutriation separate the Sand from the Clay, dry and weigh them : If there be any Pyrites it will appear in the Sand.

In the above Processes the principal Things to be attended to, are,

Whether there be any Metallic, or Alluminous Salts, as these are absolute Poisons, and therefore are to be decomposed by Quick Lime.

Whether there be such a Proportion of Neutral or Earthy Salts as to be hurtful, in which Case, the Solution in *Process* (Second,) will taste Salt, a Soil containing them in so large a Proportion, will hardly ever admit of Culture for Grain.

Whether there be Calcareous Earth, and in what Proportion, as that ascertains the Propriety of applying any Manure containing it, and the Quantity of that Manure.

What

What the Proportion of Sand and Clay is, which ascertains the Propriety of adding Sand or Clay.

Whether there be Pyrites as that shows why, and when a Soil will be long of being brought into Cultivation.

Pyrites are best destroyed by Fallowing, and afterwards applying Lime.

EXPLANATION of the PLATES.

FIG. I.

FROM Experiment it is found, that Bodies upon cooling contract and retain their Shape; therefore that they contract in every Direction.

Suppose AAA BBB to represent the Section of a Sphere, the Diameters AB upon the Sphere's being cooled, become equally shorter in all their Parts; but if the Particles lying in the Direction of these Diameters touched, they could not come nearer, and the Diameters could not contract, it is evident that the Particles do not touch.

FIG. II.

The Particles OO of the Oil, attracting one another stronger than they do the Particles WW, &c. of the Water, from a Globule GG, surrounded by the Particles WW, &c. of the Water,

FIG. III.

The Particles S of the Serum, attracting the Particles W of the Water, as strongly as they do one another, they intermix together equally.

FIG IV.

Suppose N a Sphere of Iron immersed in Water, it would be surrounded by the Particles of Water W W, &c. in order to sink through the Water it must separate the Particles D D from one another, and therefore must overcome their Attraction, and it must slide along the Particles C B and therefore that Friction must also be overcome. If therefore the Difference of specific Gravity should not be sufficient to overcome these Resistances, the Sphere would Swim. But the resistance of the Attraction of the Particles D D will be the same nearly in a large and a small Sphere, and the total Difference of the Gravity of a small Sphere and an equal Bulk of the Fluid, will be less than the total Difference of the Gravity of a large Sphere and an equal Bulk of the Fluid; if therefore you could diminish the Sphere until that Difference is less than the Attraction of the Particles D D it would Swim.

FIG. V.

As the Particles of Bodies do not touch but adhere by Attractions, and Repulsions, they may be considered as acting at the Sphere, where their Attractions are in Equilibrio. If there be four Particles P P P P, they may be considered as producing their Effects at the Spheres A A A A.

F I G. VI.

When two Particles PP are chemically combined, they may be considered as united at the chemical Sphere of Action C, and now to have acquired one common Sphere of Mechanical Action M, their former Spheres of Mechanical Action being lost during their chemical Combination.

F I G. VII.

Thus a Particle of Volatile Alkali, may unite chemically with a Particle of an Acid, forming Sal Ammoniac, in which they have one common Sphere of Chemical Attraction, at which they may unite with Copper, and when so combined, the three Particles acquire one Sphere of Mechanical Action.

F I G. VIII.

Substances evaporate more or less readily according to the Pressure on their Surface; suppose therefore, that a Fluid consists of Rows of Particles ABC the upper Row A has only the Pressure of the Atmosphere, but the next Row B, has both the Pressure of the Atmosphere, and the Pressure of the upper Row, therefore the upper Row A will evaporate most readily, and as boiling Fluids are heated equally, and it will require a greater Heat to evaporate the Row B than the Row A the whole Evaporation will take place from the Surface.

E I N I S.

Fig. 1st

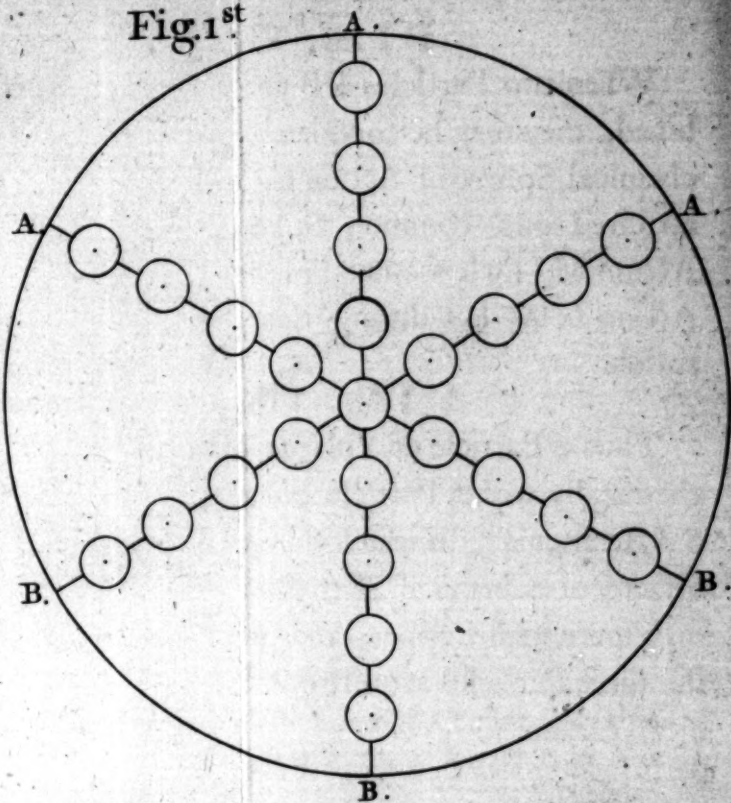


Fig. 2^d

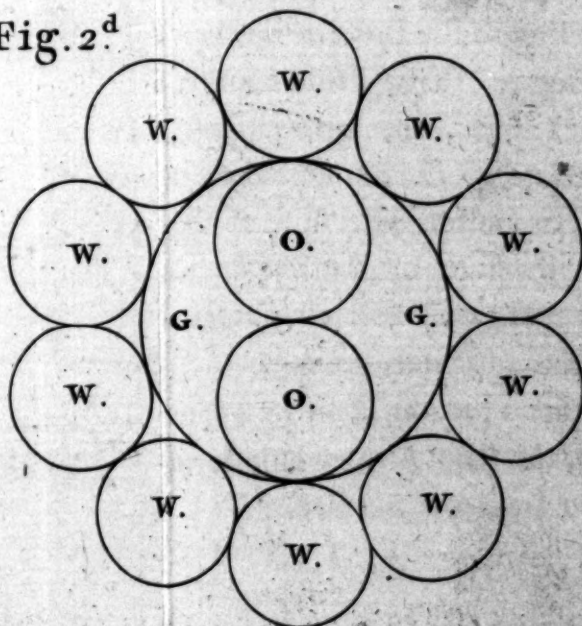


Fig. 2. A



Fig. 4

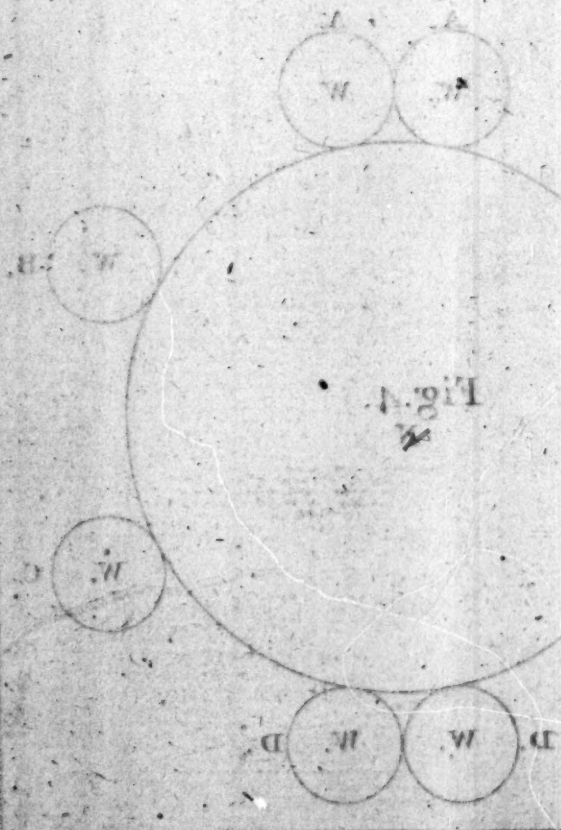
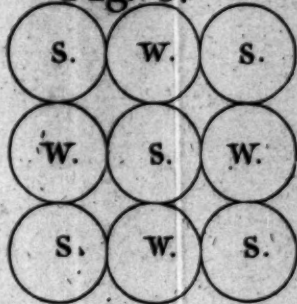


Fig. 3.



A Fig. 5. A

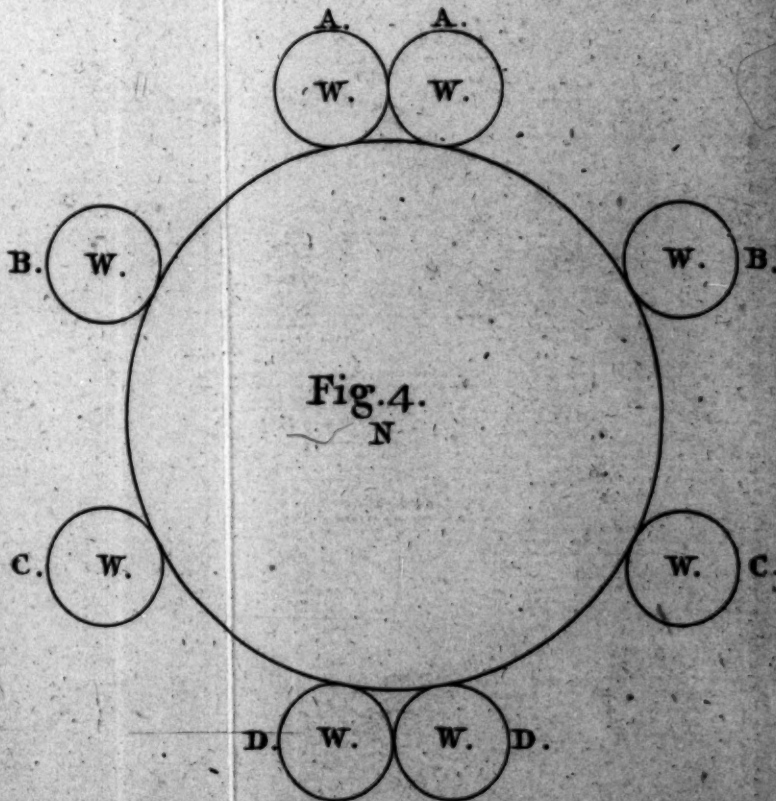
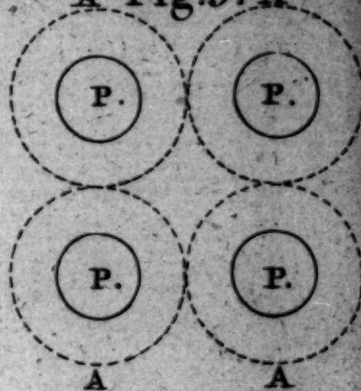


Fig. 6.

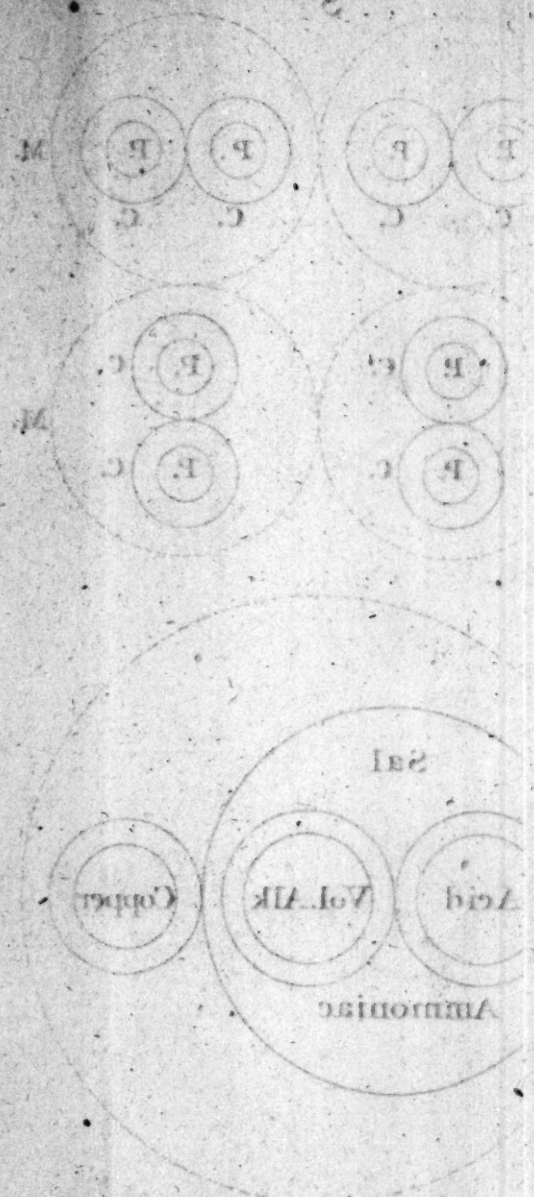


Fig. 8.

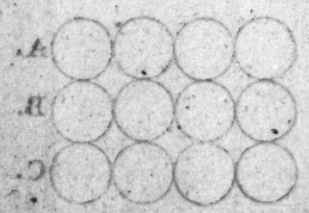


Fig. 6.th

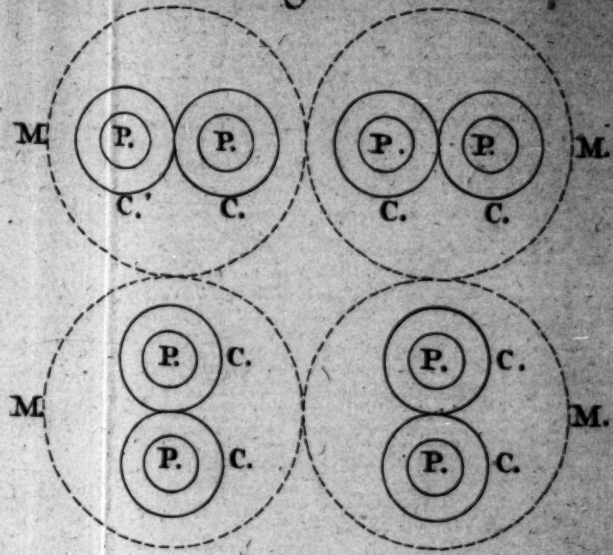


Fig. 7.th

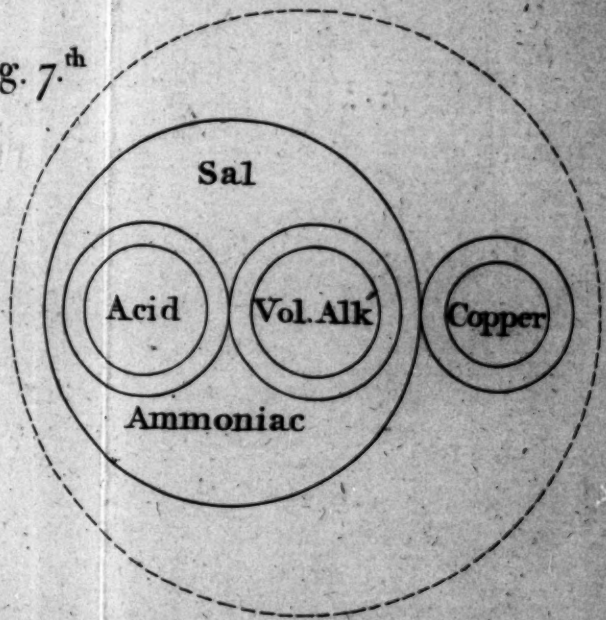


Fig. 8.th

